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Variables in Turbidity Testing

Teri T. Snazelle
U.S. Geological Survey
Hydrologic Instrumentation Facility

Turbidity Basics

- Qualitative or Quantitative?
- NOT a direct measurement
- Particle size, color, and sensor configuration affect the measurement

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EPA180.1 vs ISO7027

EPA 180.1

- Tungsten lamp source with color temp 2000-3000 °K
- Photodetector angle 90° ± 30°
- Aperture angle not specified
- Spectral peak response 400-600 nm

ISO 7027

- Monochromatic light source
- Photodetector angle 90 ° ± 2.5°
- Aperture angle 20-30°
- Spectral peak @ 860 +/- 30 nm

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Turbidity Nomenclature

NTU

FBRU

FNU

FBU

AU

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Turbidity NWIS PCODE

water.usgs.gov/owq/turbidity/turbidity_codes.xls

Version: May 2012									
NWIS PCODE	Method Short Name	Method Source (NWQL, EPA, ASTM, Std. Meth., etc.)	Method Number	NWIS New Method Code	NWIS Old Method Code	Is Method Approved? (meets require-ments in OWQ Tech Memo 98.05)	Static / Submersible / Process	Comments	Website
NTU (Nephelometric Turbidity Units) Instruments-White or Broadband (400-680 nm) light source, 90 degree detection angle, one detector.									
63675	Chemtrac , Sensor model TruTrac, NTU	EPA	180.1	TS135	N/A	N/A	Process	For drinking water, treatment plant operations. Range 0-200 NTU	
63675	Cole-Parmer Instruments, Sensor Model EW-08391-40, NTU	EPA	180.1	TS137	N/A	N/A	Static (Portable)		http://www.colepalmer.com
63675	ConFab Instrumentation 850I, NTU	EPA	180.1	TS158	N/A	N/A	Process	In-line measurements provide instantaneous readings	
63675	ConFab Instrumentation 850S, NTU	EPA	180.1	TS159	N/A	N/A	Submersible	Sensor can be submersed to 110 foot depth	
63675	ESD, Sensor Model 800 / 800P, NTU	EPA	180.1	TS089	T	N/A	Static	Discontinued. Model 800P is portable.	
63675	Eutech Instruments, Sensor model TB1000, NTU	EPA	180.1	TS136	N/A	N/A	Static (Portable)	waterproof. Has infraRed-light version (FNU)	http://www.eutechinst.com
63675	Global Water Inst. TB 500 WL,NTU	EPA	180.1	TS160	N/A	N/A	Process		
63675	HACH, sensor model 1720 C, NTU	EPA	180.1	TS094	C	N/A	Process		
63675	HACH, sensor model 1720 D, NTU	EPA	180.1	TS095	D	N/A	Process	Submersible probe, in pipe	
63675	HACH, sensor model 1720 E, NTU	EPA	180.1	TS096	E	N/A	Process		
63675	HACH, sensor model 2100 AN (Ratio OFF), NTU	EPA	180.1	TS097	A	N/A	Static	Flow-through accessory provides more dynamic measurement, making readings more stable.	
63675	HACH, sensor model 2100 N (Ratio OFF), NTU	EPA	180.1	TS099	B	N/A	Static	Flow-through accessory provides more dynamic measurement, making readings more stable.	

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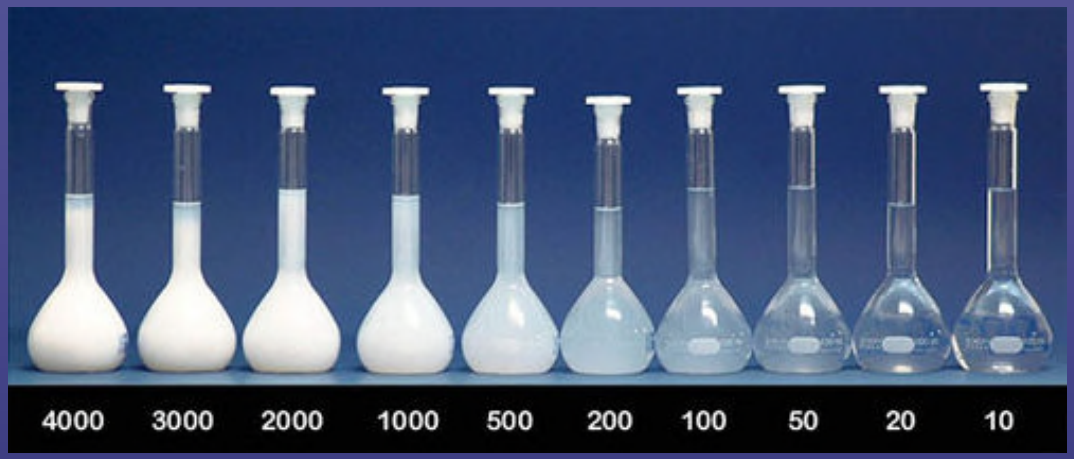
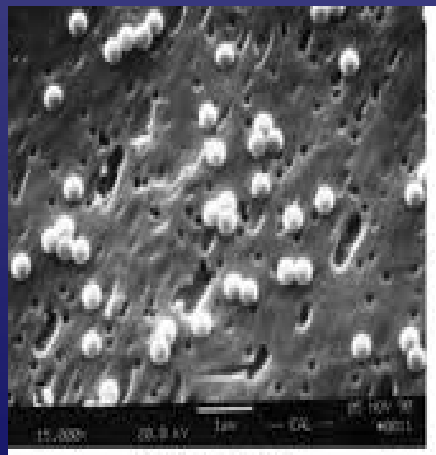
Turbidity Standards





AMCO Particles

Formazin Particles

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StablCal

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AMCO-Clear

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Nephelometric Design

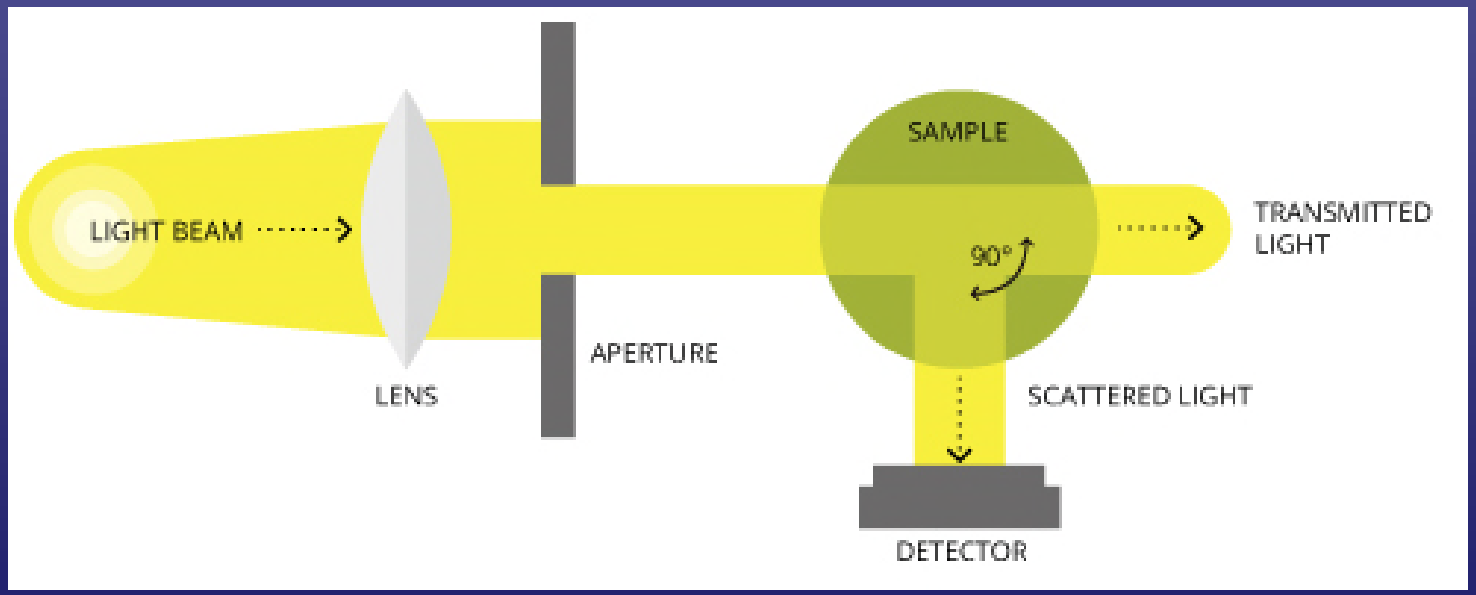

Diagram credit to Christine Kemker, Fondriest Environmental, Inc.

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Nephelometric Sensors

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Backscatter Design

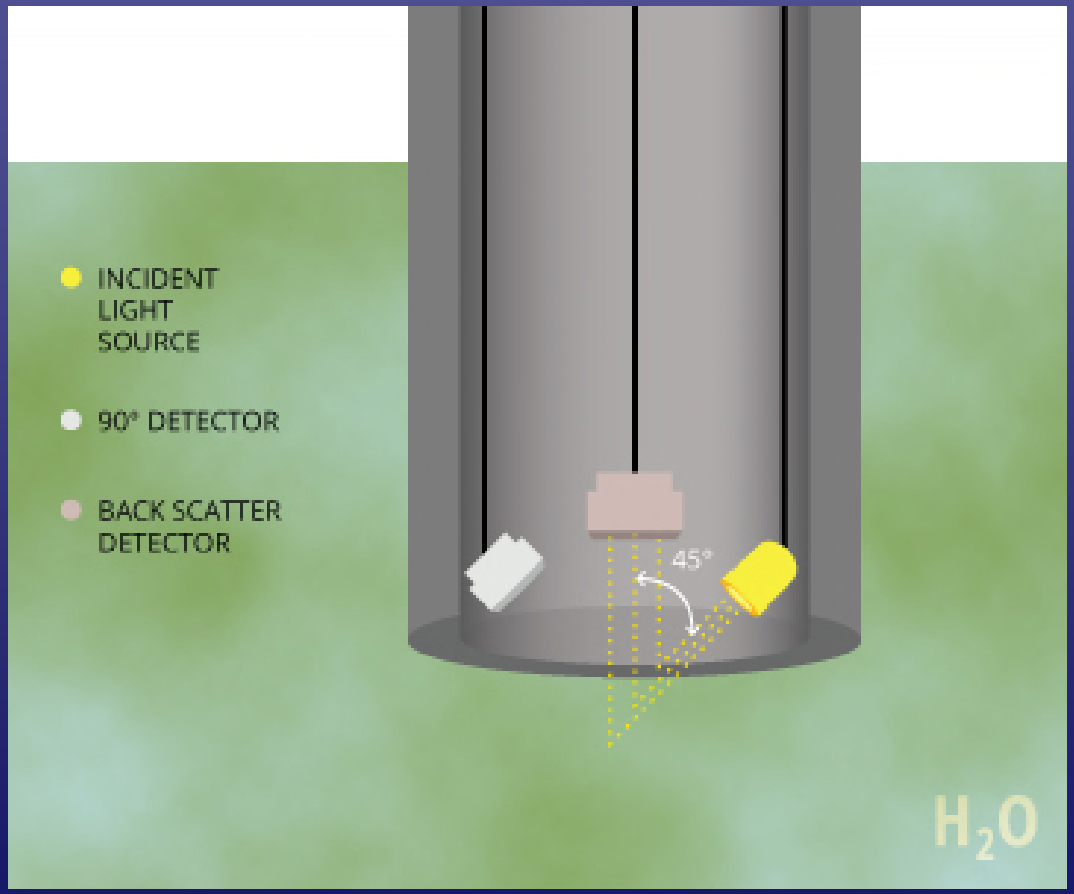

Diagram credit to Christine Kemker, Fondriest Environmental, Inc

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“Modified” ISO 7027 Nephelometric Sensor

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Backscatter Sensors

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Ratio Designs

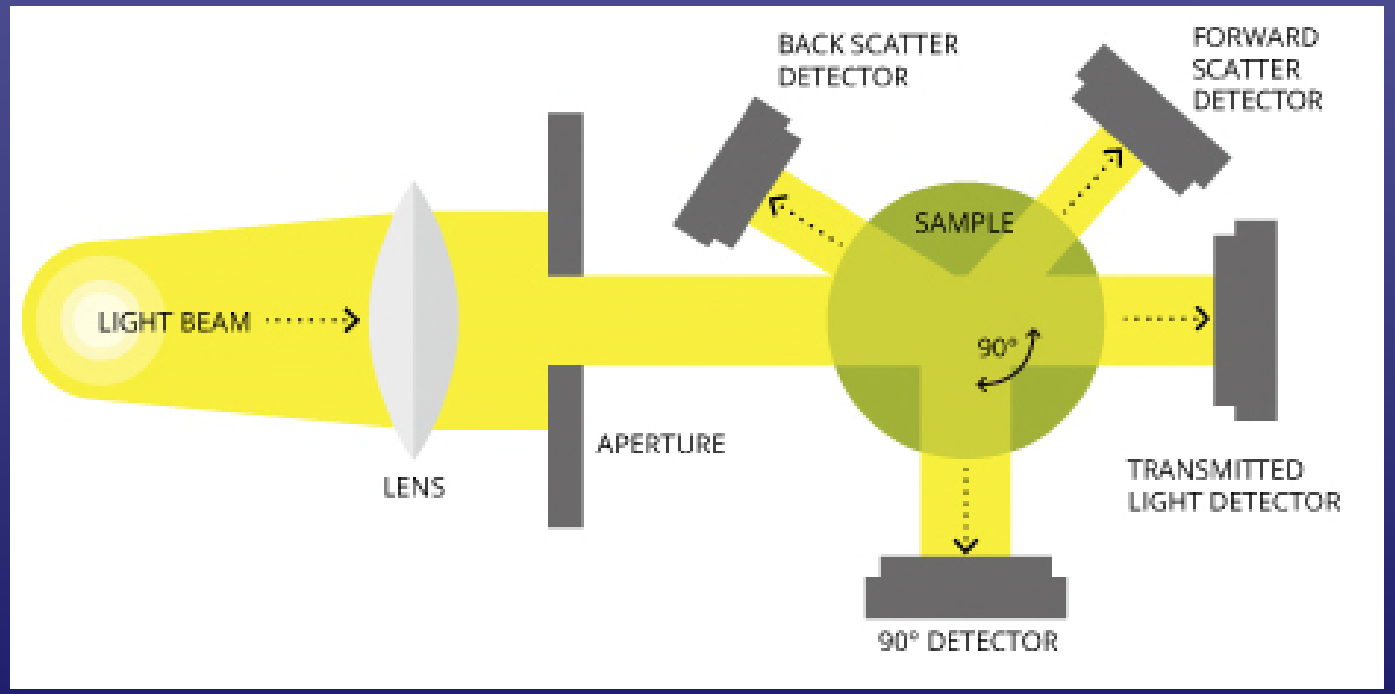

Diagram credit to Christine Kemker, Fondriest Environmental, Inc

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Formazin Backscatter Ratio Sensor

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Formazin Backscatter Ratio Sensor

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Comparable Data

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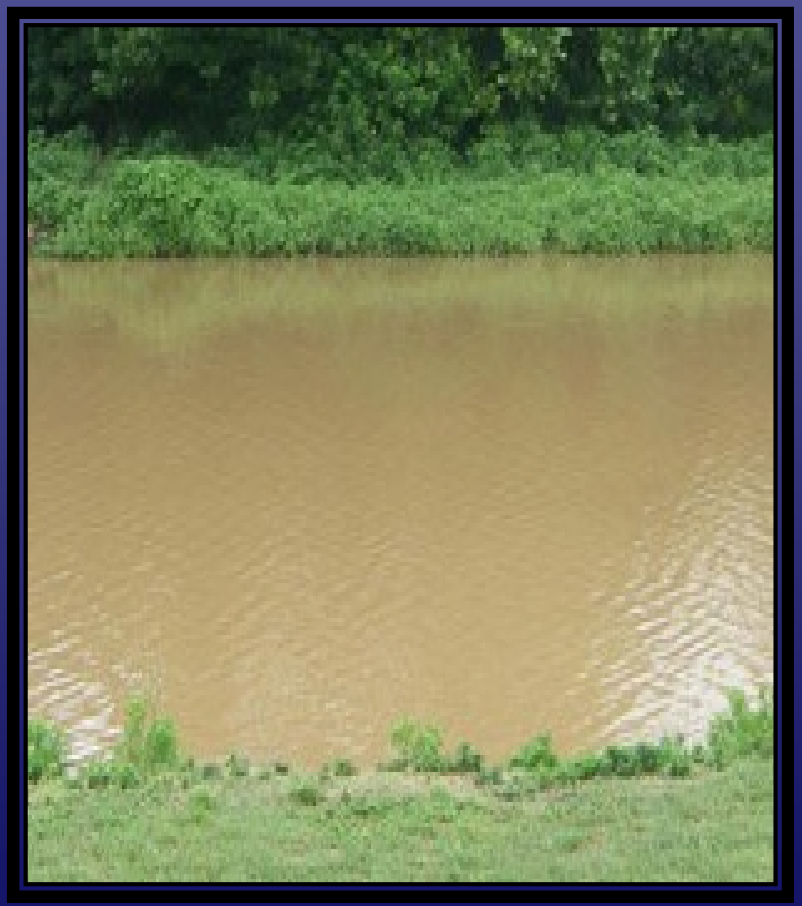

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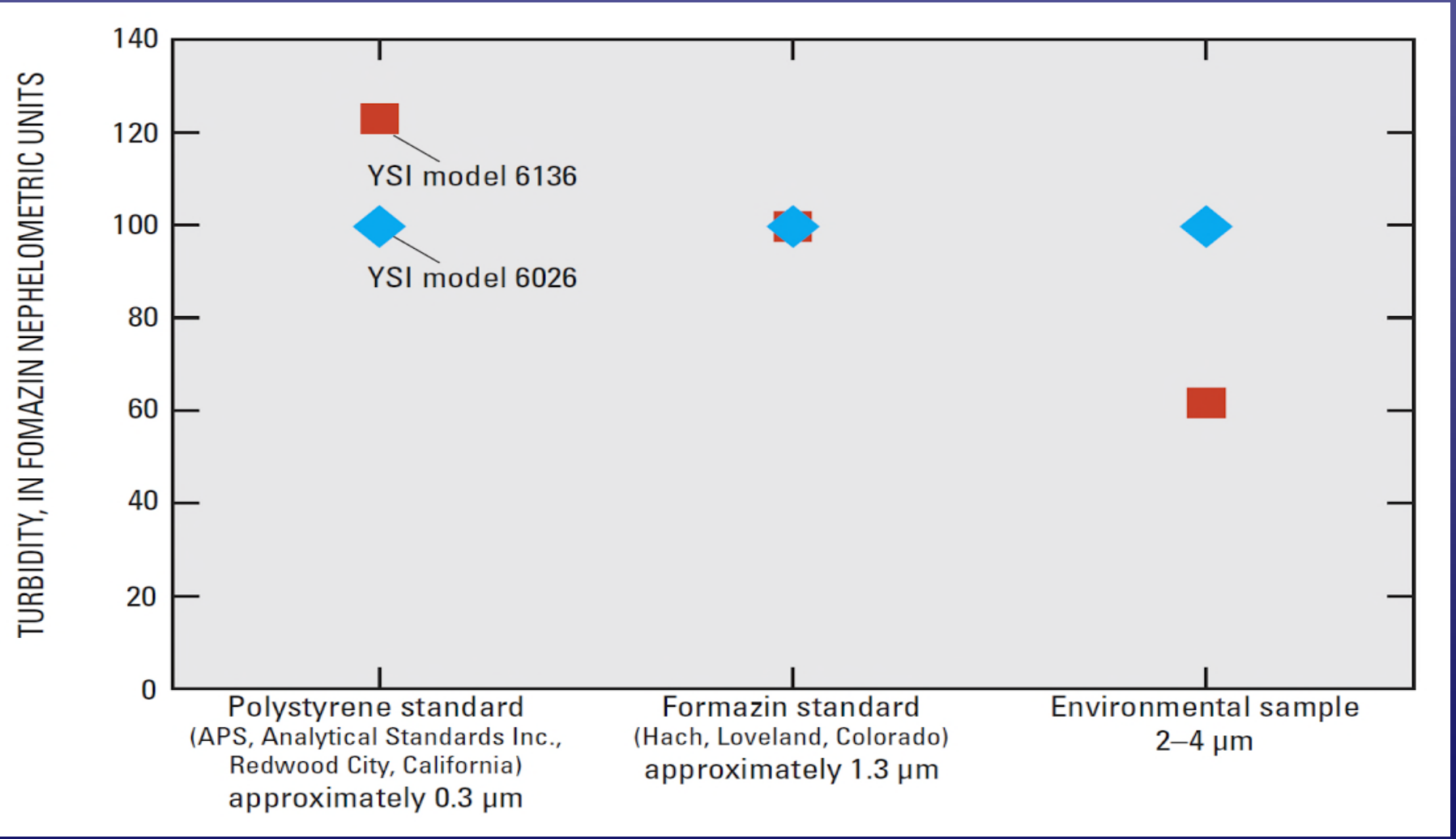
USGS Techniques and Methods 3-C4

(Rasmussen and others, 2009)



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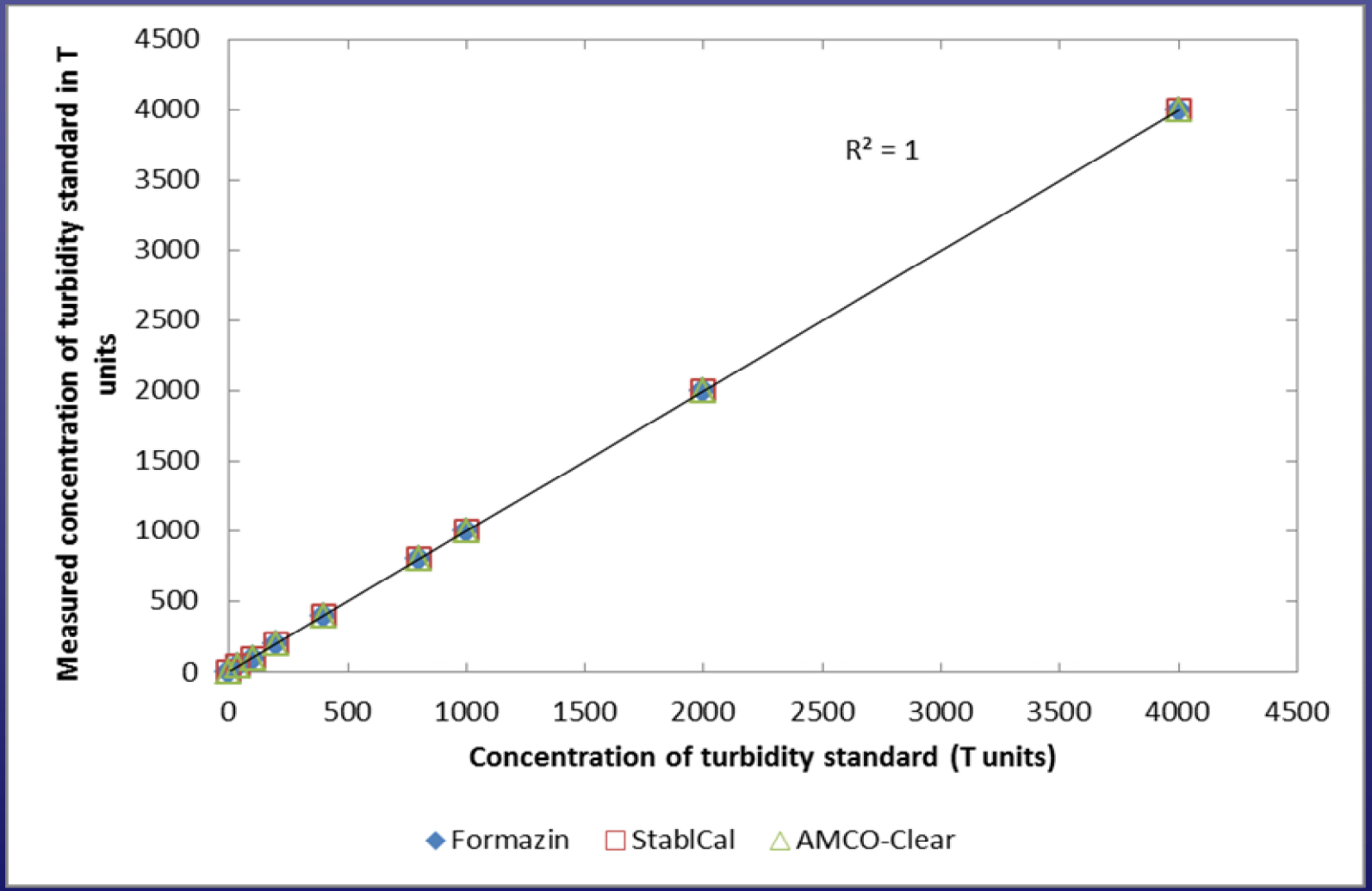
Fantasy



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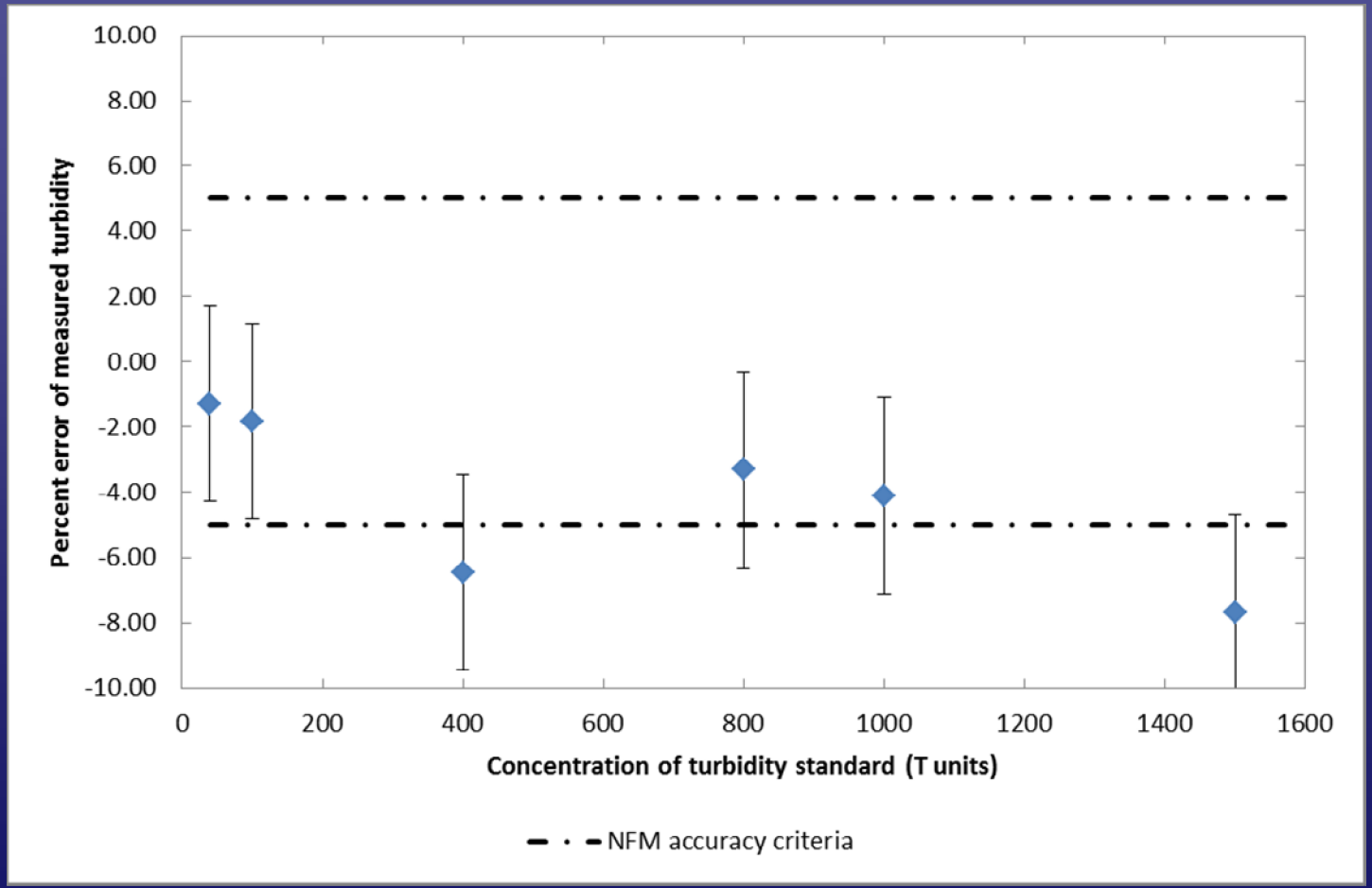
Reality – Calibrated in Formazin/ Checked in Formazin



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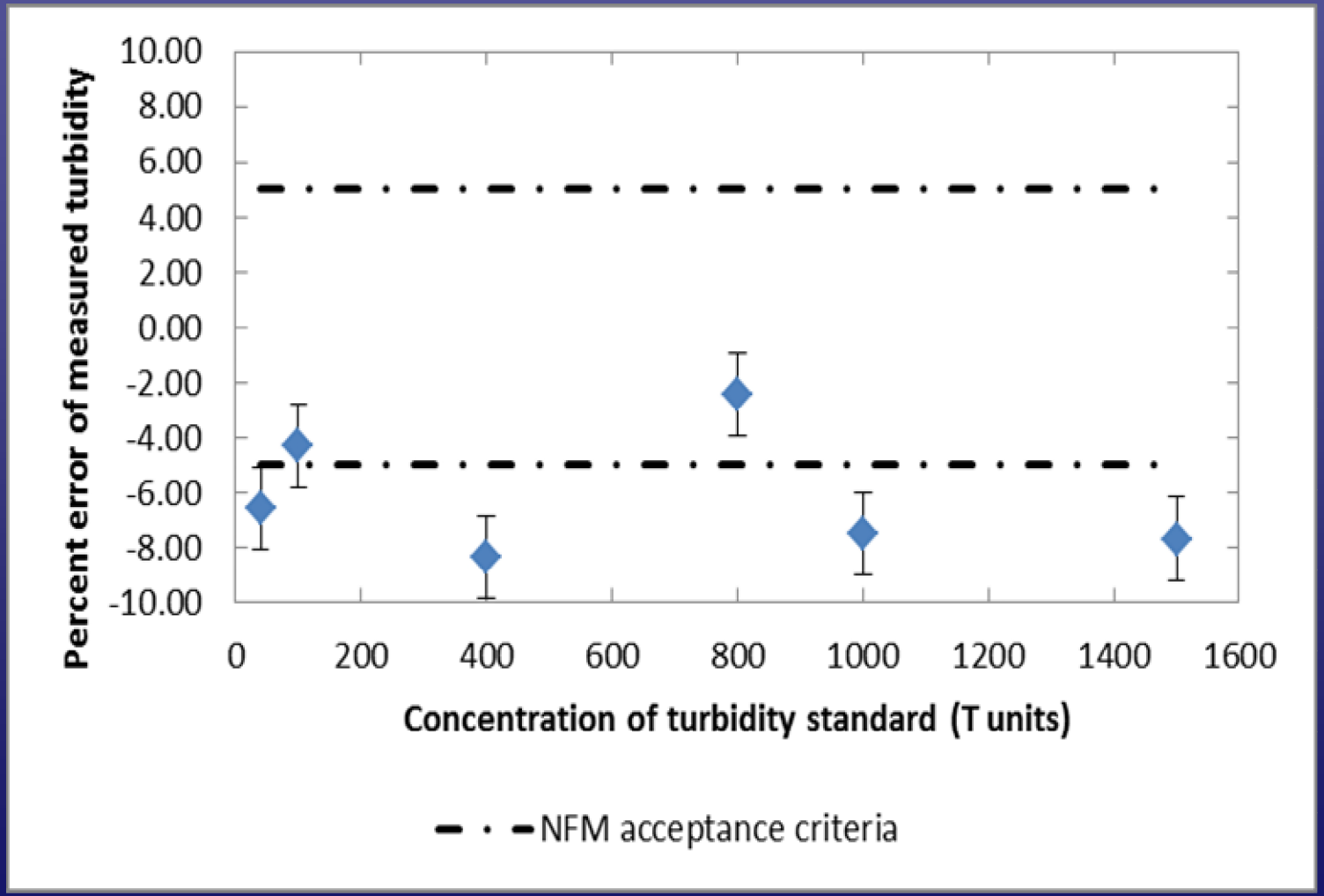

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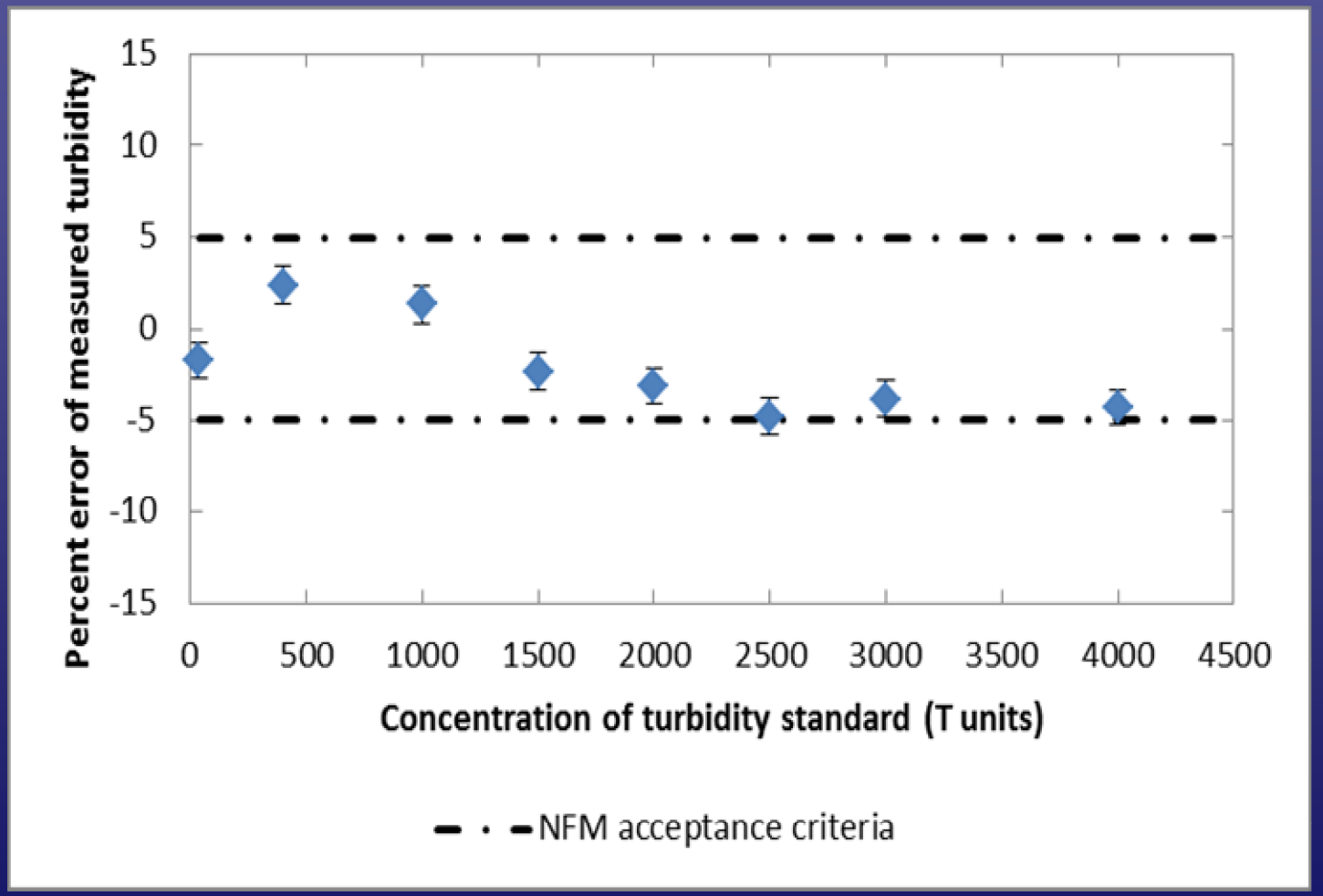
Reality – Calibrated in AMCO-Clear/Checked in AMCO-Clear



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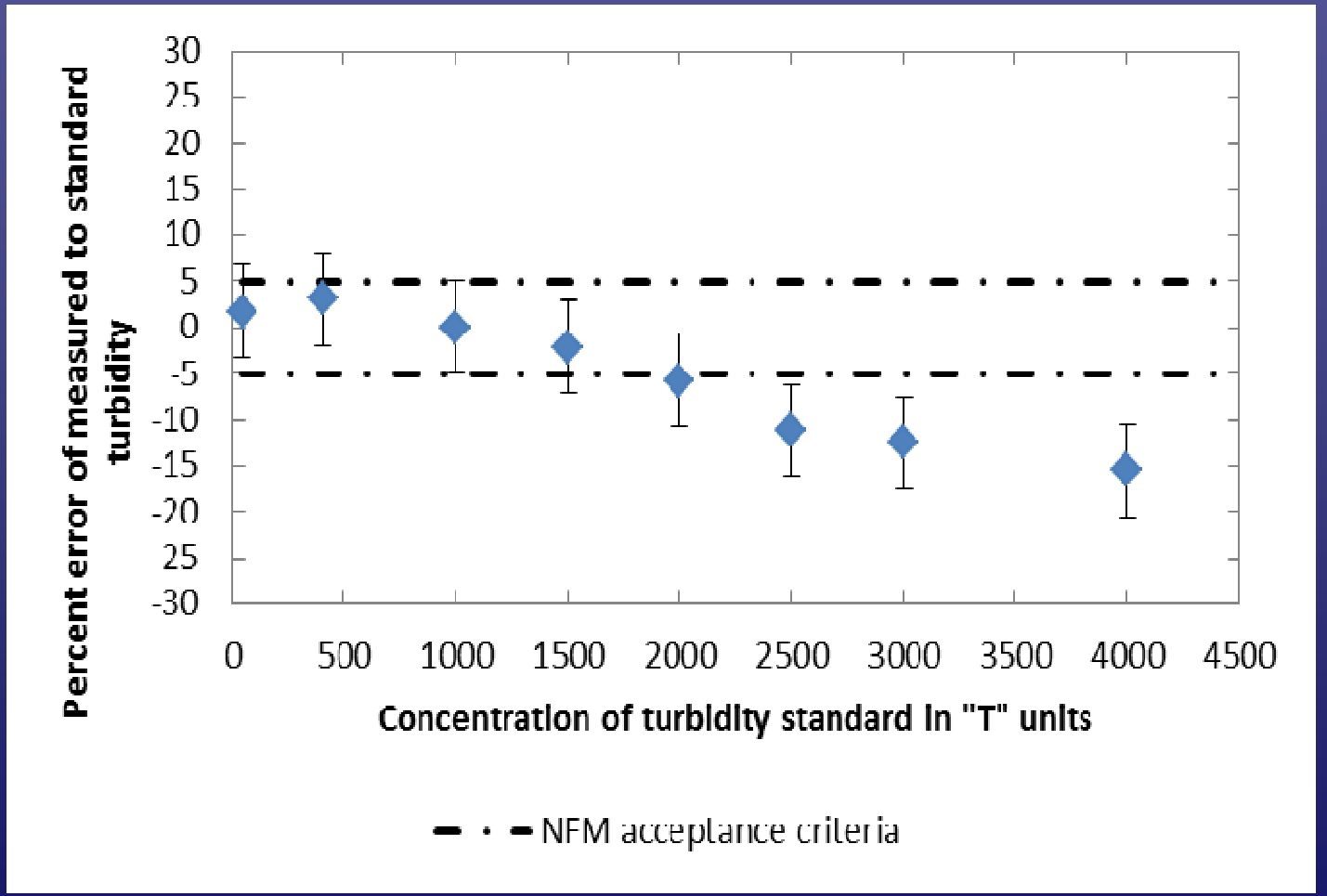
Reality – Calibrated in AMCO-Clear/Checked in Formazin



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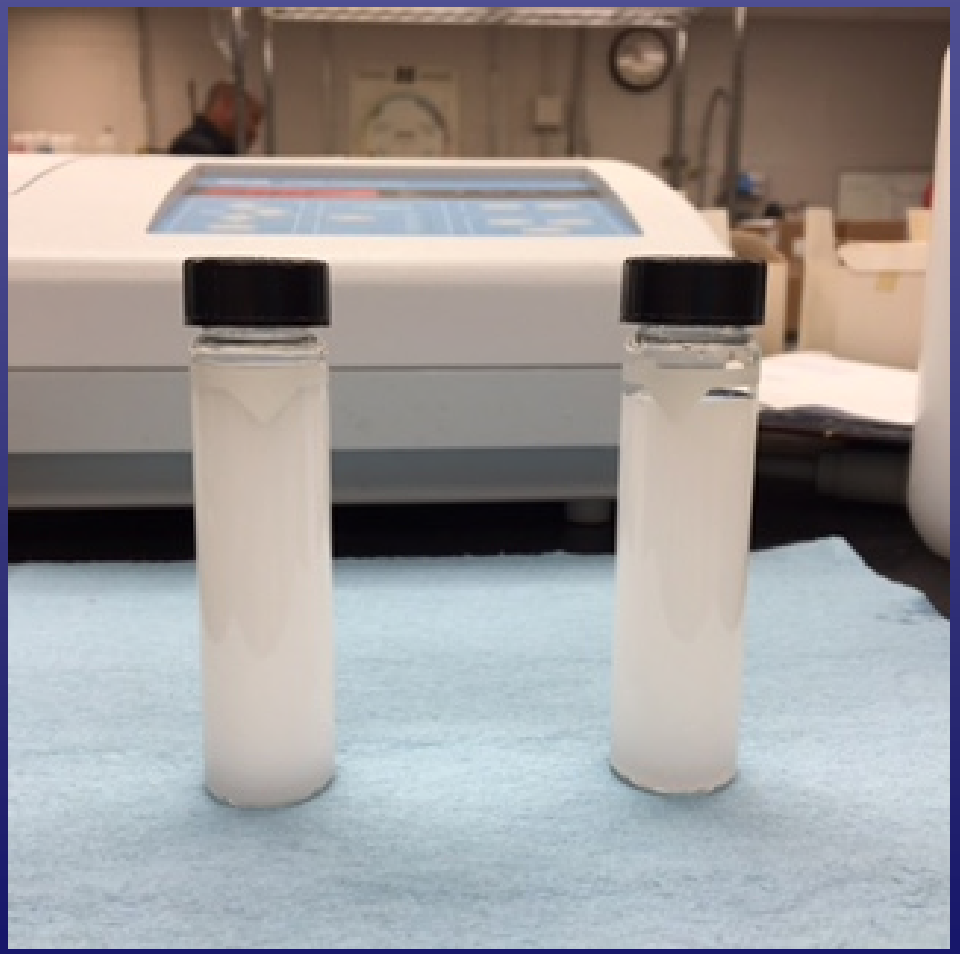
Two Different 4000 NTU Standards



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Things to Keep in Mind

- Differences in sensor design will cause sample measurement to vary
- No two turbidity models will give the same reading in “real” samples
- All instruments should read the actual standard value in formazin
- Polystyrene standards are sensor specific
- Instrument calibrations aren’t always accurate due to standard uncertainty

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What to do?

- Don’t mix turbidity standards
- Remember that turbidity is NOT a direct measurement
- Give yourself some “wiggle” room
- Verify the accuracy and the operating range after calibration
- Ask for help and BREATHE

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Questions?

Teri Snazelle
(800) 382-0634 ext. 1316
tsnazelle@usgs.gov

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